

CLAIMS

What is claimed is:

1. A method for preparing a mixed metal oxide layer, comprising:
 - (a) preparing a suspension having nanoparticles including solid mixed metal oxide material,
 - (b) dispensing at least a portion of the suspension onto a substrate;
 - (c) spinning the substrate to produce a coated substrate;
wherein the spinning technique having at least one of
 - (i) spin coating, and
 - (ii) centrifuging; and
 - (d) heating the coated substrate to form an mixed metal oxide layer.
2. The method according to claim 1 wherein the mixed metal oxide comprises a material selected from the group consisting of doped Ce, doped Zr, and mixtures thereof.
3. The method according to claim 1 wherein the spinning technique comprises spin coating.
4. The method according to claim 1 wherein the spinning technique comprises centrifuging.
5. The method according to claim 1 wherein the suspension has an aqueous continuous phase.
6. The method according to claim 1 wherein the suspension has a non-aqueous continuous phase.
7. The method according to claim 1 wherein the mixed metal oxide is an electrolyte material.
8. The method according to claim 7 wherein the electrolyte material comprises a material selected from the group consisting of SDC, GDC, YSZ,

cubic fluorite structures, doped cubic fluorite, proton-exchange polymer, proton-exchange ceramics, and mixtures thereof.

9. The method according to claim 1 wherein the nanoparticles comprise about 5 to about 75 nm.

10. The method according to claim 1 wherein the suspension further comprises an additive.

11. The method according to claim 10 wherein the additive is a binder.

12. The method according to claim 10 wherein the additive is a dispersant.

13. The method according to claim 10 wherein the additive comprises a compound selected from the group consisting of polyvinyl alcohol acrylic emulsions, polyamide-epichlorohydrin, acrylamide, methylcellulose, PVB, and mixtures thereof.

14. The method according to claim 10 wherein the additive is PVOH.

15. The method according to claim 1 wherein the substrate comprises an material selected from the group consisting of Al_2O_3 , electrode material, anode material, quartz, silicon, ceramics and mixtures thereof.

16. The method according to claim 1 wherein step (c) is carried out in a stepwise process comprising increasing spin rates.

17. The method according to claim 1 further comprising step (e) heating the coated substrate to a temperature exceeding 600°C.

18. The method according to claim 1 further comprising step (e) heating the coated substrate to a temperature exceeding the point at which recrystallization of the mixed metal oxide material begins.

19. The method according to claim 1 further comprising adding one or more electrolyte layers by repeating steps (b) – (d).
20. The method according to claim 19 further comprising step (e) heating the coated substrate to a temperature exceeding 600°C.
21. A method for forming an electrolyte layer, comprising:
 - (a) depositing step for locating one or more intermediate layers of a colloidal dispersion on a substrate, the colloidal dispersion having nanoparticles of electrolyte material and a liquid continuous phase;
 - (b) successively drying each intermediate layer; and
 - (c) firing to form an electrolyte layer.
22. The method according to claim 21 wherein the depositing step comprises spin coating.
23. The method according to claim 21 wherein the depositing step comprises centrifuging.
24. The method according to claim 21 wherein the firing step is performed after each successive drying step.
25. The method according to claim 21 wherein the firing step is performed after two or more successive drying steps.
26. An electrolyte material comprising an oxide material formed from a colloidal dispersion having electrolyte material and a liquid continuous phase; wherein the dispersion was deposited as one or more thin films each film dried to form an intermediate layer and fired to form an electrolyte material.

27. The electrolyte according to claim 26 wherein the dispersion is a stable suspension.
28. The electrolyte according to claim 26 wherein the liquid continuous phase comprises an aqueous phase.
29. The electrolyte according to claim 26 wherein the liquid continuous phase comprises a non-aqueous phase.
30. The electrolyte according to claim 26 wherein the deposition of the film comprises spin coating.
31. The electrolyte according to claim 26 wherein the deposition of the film comprises centrifuging.
32. The electrolyte according to claim 26 wherein the firing is performed after each drying step.
33. The electrolyte according to claim 26 wherein the firing is performed after two or more drying steps.
34. A mixed metal oxide layer formed by the process of:
- (a) spinning one or more intermediate layers of a colloidal suspension on a substrate, the colloidal suspension having nanoparticles of solid mixed metal oxide material and a liquid continuous phase;
 - (b) successively drying each intermediate layer; and
 - (c) firing to form a mixed metal oxide layer.
35. The layer according to claim 34 wherein the spinning of intermediate layers comprises spin coating.

36. The layer according to claim 34 where in the spinning of intermediate layers comprises centrifuging.